BEST AVAILABLE IMAGES

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images may include (but are not limited to):

- BLACK BORDERS
- TEXT CUT OFF AT TOP, BOTTOM OR SIDES
- FADED TEXT
- ILLEGIBLE TEXT
- SKEWED/SLANTED IMAGES
- COLORED PHOTOS
- BLACK OR VERY BLACK AND WHITE DARK PHOTOS
- GRAY SCALE DOCUMENTS

IMAGES ARE BEST AVAILABLE COPY.

As rescanning documents *will not* correct images, please do not report the images to the Image Problem Mailbox.

PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 :
F16L 11/12, B67D 1/08, F16L 11/04

A1

(11) International Publication Number: WO 99/60297

(43) International Publication Date: 25 November 1999 (25.11.99)

(21) International Application Number: PCT/GB99/01378

(22) International Filing Date: 18 May 1999 (18.05.99)

(30) Priority Data:
9810565.3 18 May 1998 (18.05.98) GB

(71) Applicant *(for all designated States except US)*: VALPAR INDUSTRIAL LIMITED [GB/GB]; 13 Balloo Drive, Balloo Industrial Estate, Bangor, County Down BT19 2QY (GB).

(72) Inventors; and
(75) Inventors/Applicants *(for US only)*: BECKETT, Robert, Prentice [GB/GB]; 13 Balloo Drive, Balloo Industrial Estate, Bangor, County Down BT19 2QY (GB). LYNCH, Alan, John [GB/GB]; 13 Balloo Drive, Balloo Industrial Estate, Bangor, County Down BT19 2QY (GB).

(74) Agent: ROBERTSON, Robert, Bruce, Spence; 240 Upper Newtownards Road, Belfast BT4 3EU (GB).

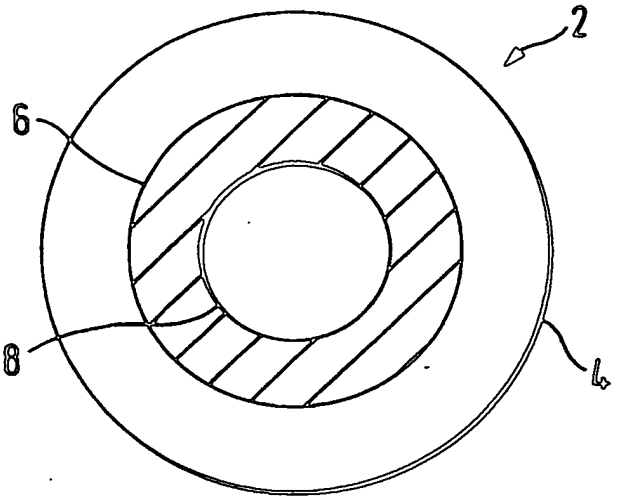
(81) Designated States: AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, GH, GM, HR, HU, ID, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZA, ZW, European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

Published
With international search report.
Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.

(54) Title: ANTIMICROBIAL PLASTIC TUBING

(57) Abstract

A plastic tubing is provided for passage of a potable liquid, the tubing having a wall structure comprising one or more concentric layers (22, 24) in one or more of which an antimicrobial substance is included, the substance being able to migrate inwardly through the tubing and be controllably released from the tubing bore (26) in use.



FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	ES	Spain	LS	Lesotho	SI	Slovenia
AM	Armenia	FI	Finland	LT	Lithuania	SK	Slovakia
AT	Austria	FR	France	LU	Luxembourg	SN	Senegal
AU	Australia	GA	Gabon	LV	Latvia	SZ	Swaziland
AZ	Azerbaijan	GB	United Kingdom	MC	Monaco	TD	Chad
BA	Bosnia and Herzegovina	GE	Georgia	MD	Republic of Moldova	TG	Togo
BB	Barbados	GH	Ghana	MG	Madagascar	TJ	Tajikistan
BE	Belgium	GN	Guinea	MK	The former Yugoslav Republic of Macedonia	TM	Turkmenistan
BF	Burkina Faso	GR	Greece			TR	Turkey
BG	Bulgaria	HU	Hungary	ML	Mali	TT	Trinidad and Tobago
BJ	Benin	IE	Ireland	MN	Mongolia	UA	Ukraine
BR	Brazil	IL	Israel	MR	Mauritania	UG	Uganda
BY	Belarus	IS	Iceland	MW	Malawi	US	United States of America
CA	Canada	IT	Italy	MX	Mexico	UZ	Uzbekistan
CF	Central African Republic	JP	Japan	NE	Niger	VN	Viet Nam
CG	Congo	KE	Kenya	NL	Netherlands	YU	Yugoslavia
CH	Switzerland	KG	Kyrgyzstan	NO	Norway	ZW	Zimbabwe
CI	Côte d'Ivoire	KP	Democratic People's Republic of Korea	NZ	New Zealand		
CM	Cameroon			PL	Poland		
CN	China	KR	Republic of Korea	PT	Portugal		
CU	Cuba	KZ	Kazakstan	RO	Romania		
CZ	Czech Republic	LC	Saint Lucia	RU	Russian Federation		
DE	Germany	LI	Liechtenstein	SD	Sudan		
DK	Denmark	LK	Sri Lanka	SE	Sweden		
EE	Estonia	LR	Liberia	SG	Singapore		

ANTIMICROBIAL PLASTIC TUBING

This invention relates to antimicrobial plastic tubing, particularly but not exclusively for the passage and transfer of beverages.

One common beverage is beer. However, the yeast and bacteria in beer adhere significantly to dispensing equipment made of synthetic plastics used in the beverage industry, especially at the point of serving, i.e. in bars, restaurants, etc. The delivery pipes and tubes (often termed "lines") in a bar should be cleaned at least once a week, and the lines are generally replaced completely every two years or so. Such cleaning and replacement involves considerable time and effort, as well as expense. The delivery lines for other beverages such as 'soft' drinks, or soft drinks components, also require regular cleaning.

According to one aspect of the present invention, a plastic tubing is provided for passage of a potable liquid, the tubing having a wall structure comprising one or more concentric layers in one or more of which an antimicrobial substance is included, the substance being able to migrate inwardly through the tubing and be controllably released from the tubing bore in use.The use of multiple layers for the tubing provides significant flexibility in how and where the antimicrobial substance is located, the general physical properties of the tubing, and how the antimicrobial substance is released.

In this regard, one objective of the present invention is to control the rate of release of the antimicrobial substance from the bore of the tubing. Controlled rate of release provides at least two advantages. Firstly, some assurance that the concentration of antimicrobial substance in the potable liquid does not exceed a desired maximum, thus avoiding any possible toxicity

problems. Secondly, that the expected time period of the antimicrobial substance release can be estimated, such that the expected life span of the effectiveness of the tubing can be estimated. Timing for the replacement of the tubing can then be estimated.

Preferably, one or more of the layers of the wall structure of the tubing have a rate of migration of an antimicrobial substance through said layer or layers which is different to the rate of migration of the antimicrobial substance thorough one or more other layers of the tubing.

With differential rates of migration through the layers of the wall structure of the tubing, the rate of release of the antimicrobial substance into the bore may be further controlled.

The layers of the tubing may be made from any suitable thermoplastic polymer material. Those generally used having had regulation approval for the passage of potable liquids include polyethylene, polyethylene vinyl acetate (eva), nylon, and polyvinyldifluorene (PVDF). These materials provide different properties, and also have different costs. Two or more layers of the wall structure of the tubing may be of the same material.

The width of each layer of the tubing may also vary according to the properties desired. As with the width of each layer, the amount or concentration of antimicrobial substance in the relevant layer or layers may vary as desired or necessary. Two or more antimicrobial substances may be used, in the same or different layers of the wall structure of the tubing.

A number of antimicrobial substances are known which have found to have the required properties for the present invention, including being able to be included with a plastic in the forming of a tube. One particular substance is Triclosan (RTM), a well known antimicrobial agent, which has a broad

antimicrobial spectrum at low concentration, and which is known to be active against yeast and fungi.

According to a second aspect of the present invention, there is provided a method of making plastic tubing as defined above, wherein each layer is extruded and an antimicrobial substance is incorporated into the tubing by admixing the substance into one or more layers of the tubing before or during their extrusion.

The present invention preferably provides plastic tubing having a constant rate of release of antimicrobial substance from the tubing bore in use. Hence, based on the amount of use of the tubing, the effective time period of antimicrobial activity can be estimated. Such estimation is easier where the tubing is in constant use. Once all the antimicrobial substance is expected or is known to have been released, the tubing could be replaced with new tubing.

The present invention provides tubing adapted to prevent or reduce the adhesion of bacteria and other unwanted micro-organisms and substances to its bore. The adhesion of such substances to the bore of tubing carrying a potable liquid has obvious infection risks. Such adhesion also leads to "furring" of the bore, with reduced flow and possible blockage. The yeasts in beer are particularly noted for their adhesion to plastic tubing.

The tubing of the present invention may be used for the passage or transfer of any potable liquid, whether still or carbonated, alcoholic or non-alcoholic, fresh or stored. The present invention is particularly suitable for the passage of drinking water, still and carbonated flavoured beverages including soft drinks and soft drinks components, and beers, ciders, etc. The uses of the tubing extend to wherever potable liquids are made, supplied sold, and/or delivered, e.g. bars, restaurants, factories, caravans, boats

Embodiments of the present invention will now be described, by way of example with reference to the accompanying drawings, in which:-

Fig. 1 is a cross-sectional view of a first plastic tubing according to the present invention showing one wall structure;

Fig. 2 is a cross-sectional view of a second plastic tubing showing a second wall structure;

Fig, 3 is a cross-sectional view of a third plastic tubing showing a third wall structure;

Fig. 4 is a cross-sectional view of a fourth plastic tubing showing a fourth wall structure;

Fig. 5 is a cross-sectional view of a fifth plastic tubing showing a fifth wall structure;

Referring to Fig. 1 of the drawings, in a first embodiment a first plastic tubing 2 is provided for the passage of a potable liquid, e.g. soda water or beer. The wall structure of the first tubing 2 has two concentric layers, an outer layer 4 and an inner layer 6 with the inner layer 6 defining a central bore 8 for the liquid.

The outer layer 4 is formed from medium density polyethylene (MDP), which is easy to mould, provides flexibility, and is also relatively inexpensive. The inner layer 6 is made from a copolymer with an antimicrobial substance, for example Triclosan (RTM), included therein at a concentration of e.g. 3% by weight. Although many of the copolymers used in the beverage industry are possibly more expensive than e.g. MDP, organisms such as bacteria and yeast are known to have considerably less adhesion to such copolymers. Thus, the inhibitory effect of such copolymers, along with the inhibitory effect of the antimicrobial substance, may outweigh the cost of such an inner layer,

in order to provide much cleaner tubing, and a much greater life span of tubing before it needs replacing.

In use, as liquid flows along the tubing bore 8, the antimicrobial substance is released from the inner layer 4, thereby helping to prevent the build up of any bacteria or other unwanted substances on and along the bore 8. As the antimicrobial substance at the edge of the inner 4 is released, the substance behind it migrates forward towards the bore 8. Hence all the substance is eventually released over a period of time.

In a second embodiment as shown in Fig. 2, a second tubing 20 has a wall structure comprising an outer layer 22 and an inner layer 24 with a bore 26 being defined by the inner layer 24. The inner layer 24 includes the substance at a concentration of 0.5% by weight. The outer layer 22 also includes the substance, but at a concentration of 3-5% by weight. Hence, once the substance in the inner layer 24 is released into the bore 26, the substance in the inner layer 24 will be replenished by the substance in the outer layer 22. The rate of replenishment, and thus also possibly the long-term rate of release of the substance from the inner layer 22 into the bore 26, may depend upon the difference in the concentrations of the substance in the inner and outer layers 24, 22, and the rates of migration of the substance across the inner and outer layers 24, 22. In this way, it should be possible to vary the rate of release.

For instance, the inner layer 24 could be of a material which has a rate of migration of the substance therethrough which is different to that of the outer layer 22; preferably a lower rate of migration. With a lower rate of migration, it is the inner layer 24 which controls the rate of release of the substance from the inner layer 24 into the bore 26 of the second tubing 20. The outer layer 22 acts as the reservoir of the substance. The outer layer 22

could also be formed from a plastics material which is able to support a high concentration of the substance, thereby creating a significant reservoir, and significant effective life span of the substance release.

In a third embodiment as shown in Fig. 3, a third plastic tubing has a wall structure of only one layer 30, of MDP with a bore 32 defined therein. The antimicrobial substance used is at a concentration of 2% by weight.

In a fourth embodiment as shown in Fig. 4, a fourth plastic tubing has a wall structure of three concentric layers, an inner layer 40 of nylon an intermediate layer 42 of eva and an outer layer 44 of nylon with a bore 46 defined by the inner layer 40. The inner layer 40 includes the antimicrobial substance at a concentration of 1% by weight. Also, the intermediate layer 42 includes the antimicrobial substance at a concentration of 2% by weight.

In a fifth embodiment as shown in Fig. 5, a fifth plastic tubing has a wall structure similar to the fourth plastic tubing and like parts and denoted by like numerals. The difference in this embodiment is that the intermediate layer 42 does not have any antimicrobial substance.

In all embodiments, the inner layer, at least, of the wall structure is of material having regulatory approval for the passage of potable liquids.

Clearly the width of the layers in the above examples can be varied as desired or necessary, as can the concentration of antimicrobial substance in each layer, within manufacturing and toxicity limits. A wider layer may be desired for greater strength, and increased antimicrobial substance inclusion. The width and nature of each layer may also be gauged against cost, where e.g. MDP is significantly cheaper than eg. PVDF.

The present invention provides plastic tubing, which, whilst preferably maintaining the known desired properties for its use, e.g. longitudinal flexibility, ease of forming and handling, also provides significant flexibility and control in

the rate of release of an antimicrobial substance therefrom. There is also control over the cost of different materials and time span of release. In particular, the rate of release of an antimicrobial substance into the bore of the tubing can be readily controlled by using an inner layer of rate-determining material.

Variations and modifications can be made without departing from the scope of the invention described above and as claimed hereinafter.

CLAIMS

1. A plastic tubing is provided for passage of a potable liquid, the tubing having a wall structure comprising one or more concentric layers in one or more of which an antimicrobial substance is included, the substance being able to migrate inwardly through the tubing and be controllably released from the tubing bore in use.

2. A plastic tubing as claimed in Claim 1, wherein at least two layers are provided and one or more of the layers of the wall structure of the tubing have a rate of migration of an antimicrobial substance through said layer or layers which is different to the rate of migration of the antimicrobial substance thorough one or more other layers of the tubing.

3. A plastic tubing as claimed in Claim 2, wherein with different rates of migration through the layers of the wall structure of the tubing, the rate of release of the antimicrobial substance into the bore is further controlled.

4. A plastic tubing as claimed in any one of Claims 1 to 3, wherein the or each layer of tubing is made from any suitable thermoplastic polymer material.

5. A plastic tubing as claimed in any one of Claims 2 to 4, wherein two or more layers of the wall structure of the tubing is of the same material.

6. A plastic tubing as claimed in any one of Claims 1 to 5, wherein the width of the or each layer of the tubing varies according to the properties desired.

7. A plastic tubing as claimed in any one of Claims 1 to 6, wherein the amount or concentration of antimicrobial substance in the relevant layer or layers varies as desired or necessary.

8. A plastic tubing as claimed in any one of Claims 2 to 7, wherein two or more antimicrobial substances are used on the same or different layers of the wall structure of the tubing.

9. A plastic tubing as claimed in any one of the preceding Claims, wherein the antimicrobial substance is Triclosan (RTM).

10. A method of making plastic tubing as claimed in any one of Claims 1 to 9, wherein each layer is extruded and an antimicrobial substance is incorporated into the tubing by admixing the substance into one or more layers of the tubing before or during their extrusion.

11. A plastic tubing substantially as hereinbefore described with, reference to Fig. 1 of the drawings.

12. A plastic tubing substantially as hereinbefore described with, reference to Fig. 2 of the drawings

13. A plastic tubing substantially as hereinbefore described with, reference to Fig. 3 of the drawings

14. A plastic tubing substantially as hereinbefore described with, reference to Fig. 4 of the drawings

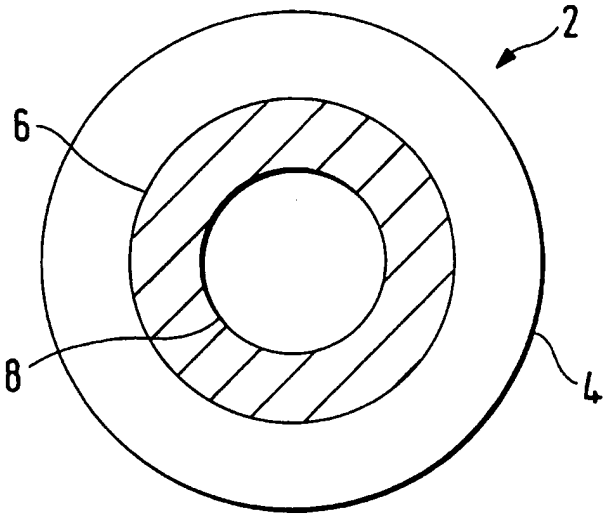


FIG. 1

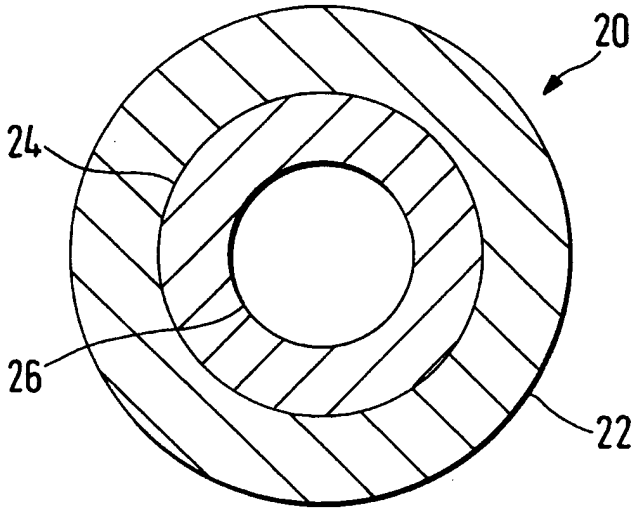


FIG. 2

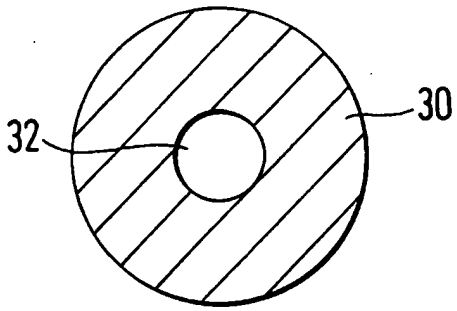


FIG. 3

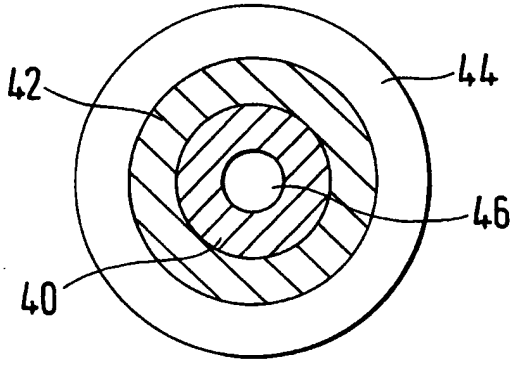


FIG. 4

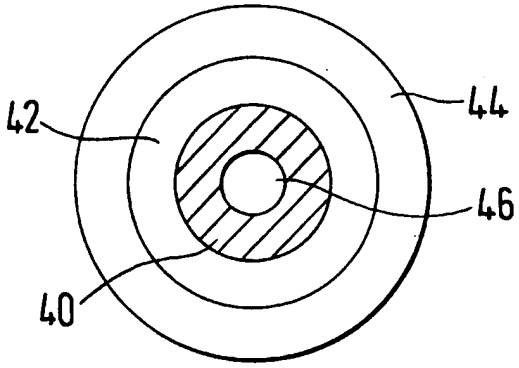


FIG. 5

INTERNATIONAL SEARCH REPORT

Internati· ' Application No
PCT/GB 99/01378

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 F16L11/12 B67D1/08 F16L11/04

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 F16L B67D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 332 160 A (RUSKIN RODNEY R) 26 July 1994 (1994-07-26) abstract; claims 1-3,14-16; figures 4-6	1-7,9,10
X	US 5 451 424 A (SOLOMON DONALD D ET AL) 19 September 1995 (1995-09-19) column 3, line 60 - column 3, line 68 column 4, line 50 - column 4, line 56; figure 9; example XIII	1-10
A	WO 96 22114 A (VITAPHORE CORP) 25 July 1996 (1996-07-25) abstract page 5, line 10 - page 5, line 32	1,9

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
15 September 1999	27/09/1999

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Donnelly, C

2

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/GB 99/01378

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5332160 A	26-07-1994	WO 9513882 A	26-05-1995
		AU 673728 B	21-11-1996
		AU 6225994 A	06-06-1995
US 5451424 A	19-09-1995	US 5165952 A	24-11-1992
		US 5013306 A	07-05-1991
		US 5707366 A	13-01-1992
		AT 103497 T	15-04-1994
		CA 2004366 A,C	18-07-1990
		DE 69007631 D	05-05-1994
		DE 69007631 T	25-08-1994
		EP 0379269 A	25-07-1990
		ES 2054229 T	01-08-1994
		IE 64997 B	04-10-1995
		JP 1993226 C	22-11-1995
		JP 2234767 A	17-09-1990
		JP 5023790 B	05-04-1993
		US 4999210 A	12-03-1991
WO 9622114 A	25-07-1996	AU 4763696 A	07-08-1996
		CA 2210119 A	25-07-1996
		EP 0804256 A	05-11-1997
		JP 11500330 T	12-01-1999